The following papers were read :—

1. On the Inheritance of Colour in Domestic Pigeons, with Special Reference to Reversion. By Richard Staples-Browne, M.A., F.Z.S.

[Received January 20, 1903.]

(Plates IV.–VII.*)

Introduction and Brief Statement of Results.

Since Darwin's classical experiments on reversion, very little inquiry has been made into the inheritance of colour in Domestic Pigeons. But with the rediscovery of Mendel's work a great impetus has been given to the study of cross-breeding; and it was considered that a repetition of experiments with Pigeons, in the light of modern knowledge of the science of genetics, would prove both interesting and instructive.

The following account contains the description of certain experiments with Pigeons, begun in 1901, which, although not identical with the matings used by Darwin, are yet planned on the lines adopted by him. Most of the pure-bred varieties used are also those with which he worked.

It will be remembered that the most striking example of reversion was obtained by Darwin as follows:—He mated a black Barb to a white Fantail, and also a black Barb to a red Spot, which is a white pigeon with the tail and tail-coverts red, having, in addition, a red spot on the forehead. He then mated together the mongrel offspring obtained from these two crosses, and from this was produced a bird identical with *Columba livia* excepting

* For explanation of the Plates, see p. 104.

that "the head was tinted with a shade of red, evidently derived from the Spot, and was of a paler blue than in the rock-pigeon, as was the stomach." (*v.* Animals & Plants under Domestication, 2nd edition, vol. i. p. 209.)

In the experiments here described, as a Spot pigeon was not readily obtainable, a black and white Nun pigeon was substituted. When the Barb-Fantail mongrels were mated to the Barb-Nun mongrels, however, no reversionary types appeared (*v.* Exps. 1, 34, 37, 38, and 39). It was, however, found that, when the Barb-Fantail crossbreds were mated together, some birds were produced having certain blue feathers. Various experiments with birds produced from the cross between the Barb and Fantail were carried out at some length, but, owing to the limitations of space, the Barb-Nun crosses were soon discontinued.

The blue colour, when it appeared, was found chiefly in the tail and neighbouring parts, as had already been observed by Darwin. Associated with this the black tail-bar was invariably present. The wing-coverts and backs of the reversionary types obtained were generally of a smoky-black colour, thus obscuring the two wing-bars found in the rock-pigeon.

The reversionary type in pigeons may in some cases be obtained in the first cross-bred generation (F. 1). Such a result Darwin observed when he crossed a Nun with a red Tumbler.

The fact that in the Barb-Fantail cross the reversionary blue does not appear until F. 2, is interesting. The F. 1 generation contains all the elements introduced by the parental types; nevertheless it is not reversionary in colour, but resembles the black Barb except for the addition of some white. From the fact therefore that the blue reversionary form can be produced by such F. 1 birds, it is clear that they contain some element which prevents the appearance of the blue. This element is evidently the factor for black self-colour; and the experiment shows that this element is dominant, or, more strictly, epistatic, to the blue. The black factor must thus be regarded as an element not derived from the wild pigeon, but added to it by some subsequent variation. When, by recombination of the various elements, the F. 2 forms are produced, those combinations which contain the blue in the absence of the black factor exhibit the blue, while those which contain the black in addition cannot exhibit it.

In some other cases of reversion on crossing (*e. g.*, Sweet Peas and Stocks), the reversion can be proved to be due to the meeting of complementary factors. In the case of the Barb-Fantail cross the evidence is not yet sufficient to show whether the factors needed to produce the atavistic condition are all present in the Barb, and their effect merely hidden by the presence of the black factor, or whether a necessary factor is introduced by the Fantail; but the fact that no blues came in the F. 2 made from F 1 (Barb × Fantail) × F. 1 (Barb × Nun) distinctly suggests that some factor of the blue did come from the Fantail.

By far the greatest number of matings here described belong to the Barb-Fantail experiment. In all 33 such matings were made. The descriptions of the pure bred birds and the several types of cross-bred birds produced are first given. The details of the various matings are then described. For the sake of clearness these are not given in the order in which they were made but are divided into three series.

Series A, comprising Exps. 1–11, deals with matings in the direct line, together with the testing of extracted whites. The results are further tabulated in Table I.

Series B (Exps. 12–26) shows the matings of crossbreds, chiefly blues, to whites, and the subsequent matings of birds derived from such crosses. Tables II. and III. deal with results in this series.

Series C (Exps. 27–33) deals with the matings of blues and blacks and the further crossings of offspring produced from such matings.

The minor characters—irides, beaks, claws, and eye-wattles—are described at the end of the paper; the details given under the descriptions of the experiments refer to plumage only.

The general results of the Barb-Fantail experiments may be briefly summarised as follows:—

The F. 1 generation shows a dominance of black to white, and the further matings show that blue is also dominant to white. This dominance of the coloured to the non-coloured type is, however, imperfect, as the majority of birds produced from the mating of black or blue with white show some white feathers, chiefly on the rump.

In the F. 2 generation the following types appear:—

Black.
Black, with some white feathers. (Black w. f.)
Blue.
Blue, with some white feathers. (Blue w. f.)
Red.
White, with some coloured feathers.
White.

The blue type may be homozygous or may be dominant to white. Black was never obtained from the mating together of two blues. The matings of blues and blacks in Series C show that blue is a simple recessive to black. The absence of white feathers in blue birds of the F. 2 generation does not necessarily indicate that they are homozygous, for Exp. 30 shows such a blue to contain white. Conversely, an F. 2 blue with some white feathers is shown in Exp. 13, when mated with a white, to produce blues with some white feathers only. The significance of the presence or absence of white feathers has not been clearly made out. It was at first thought their presence was indicative of the fact that the bird was giving off white-bearing gametes. This, however, is not

so in all cases *. From the matings of blues with white feathers, as in Exps. 11, 24, 25, and 26, whites were produced, and a definite proportion of homozygous blues was to be expected. With one exception, however, all the blues produced from these matings showed some white feathers. We are led to conclude that some of these are probably homozygous, although the assertion cannot definitely be made without testing a large quantity of such birds, of which space did not permit. On the other hand, the matings of blues with some white feathers to whites in Series B has not revealed a homozygous bird other than that in F. 2 already mentioned.

One distinctly abnormal result occurred in Series B from the mating of blues with white feathers to whites. The proportion of whites produced was here much higher than the expected equality. This result, which is discussed later, evidently points to the existence of a definite complication.

The red birds obtained in F. 2 are only briefly mentioned in the present paper. A further series of experiments, dealing with them, is now in progress, a full report of which will be published in another communication.

The majority of reds, produced in the F. 2 generation and from subsequent matings, showed a bluish tail with a very distinct bar, the under parts also having a bluish tinge. Certain specimens have, however, been produced in which the bar is absent, and the amount of blue much reduced. It is possible, therefore, that two kinds of reds may eventually be demonstrated. In addition, red has shown itself to be recessive to both black and blue, but dominant to white †.

The extracted whites, which are shown to breed true, need no comment, with the exception of five produced in the direct line (Exps. 4, 5, and 8) in which some coloured feathers were present. These are shown in Exp. 7 to produce whites with and without coloured feathers in equal numbers. It is probable that this has

* As Crampe and Doncaster have shown in rats, and Hurst in the case of rabbits, the presence of some white in otherwise self-coloured types, may be an indication of heterozygosis in respect of a pattern-factor, and the same possibility is to be remembered here.

† The results and figures so far obtained from the further experiments are briefly as follows :—

(*a*) F. 2 red × F. 2 red	gave 7 red, 1 white with few red feathers, 2 white.
(*b*) F. 2 red × F. 2 red	„ 3 red, 3 white.
(*c*) F. 2 red × F. 3 red	„ 3 red, 1 white with few red feathers, 1 white.
(*d*) F. 2 red × white	„ 2 black, 8 white.
(*e*) Black from (*d*) × white	„ 12 white, 6 blue, 2 black, 1 red.
(*f*) F. 2 red × black	„ 6 red, 4 black.
(*g*) Red from (*f*) × red from (*f*)	„ 7 red.
(*h*) F. 2 red × blue	„ 6 black, 5 blue.
(*i*) Black from (*h*) × black from (*h*) (2 pairs)	gave 10 black, 7 red, 3 blue.
(*j*) Blue from (*h*) × blue from (*h*)	gave 9 blue, 2 red.

In the above no mention is made of white feathers occurring on coloured birds; they occurred, however, on a large number, and their distribution corresponded to that in similar birds described in the present paper. It will be noticed that the number of white birds produced was above the expected proportion. Exp. (*f*) was a brother and sister mating.

been introduced by the Fantail. It is pointed out below that one of the Fantails in the strain used (Lee ♀ 7) showed a black feather. The relation between this bird and Fantail ♂ 23, the bird used in Exp. 2, is shown in a pedigree of the Fantails. Although several pairs of pure-bred Fantails were kept, "splashed" birds never appeared in their offspring. An opportunity appears to have arisen in the crossing, however, by which this latent character was able to manifest itself.

A further series of experiments was undertaken on the crossing of two distinct white breeds, Tumblers and Fantails. Here again blue colour was produced in the F. 2 generation. An account of this cross is included in the present paper.

For testing the various Mendelian ratios the pigeon is not a thoroughly satisfactory subject to work with, unless the experiments can be carried out on a very extensive scale. To insure the desired mating it has been found necessary to keep each pair of birds in a separate aviary. The number of pairs kept is therefore limited. Further, the number of offspring produced by a pair of pigeons is comparatively small, seldom exceeding ten in any one year. In a few cases, when a ratio between the numbers of the various types of offspring produced by a cross was desired, the same mating has been continued for a second year.

In the following account the ordinary Mendelian terms are used.

The Barb Pigeon. (Pigeon polonais.)

In 'Animals and Plants under Domestication,' Darwin describes the points of the Barb thus:—"Beak short, broad, deep; naked skin round the eyes broad and carunculated; skin over nostrils slightly swollen." It was hoped that these characters might be traced in the crossbreds, but some difficulty was experienced in obtaining accurate measurements, and the attempt was abandoned. The "eye-wattle" or cere, moreover, does not attain to its maximum development until the bird is in its fourth year. The Barb is a "self-" or whole-coloured pigeon, and is found in black, red, yellow, dun, and white. Of these black is the commonest. Blue Barbs are exceedingly rare, and are seldom if ever used by breeders for crossing with the other colours. No wing- or tail-bars, or chequering are found in the usual colours. The eye-wattle is bright red. The iris is generally white, sometimes orange, and in white Barbs is black. The beak and claws are desired by breeders to be white; there is, however, a tendency for black Barbs to have the beak tipped with black, or even horn-coloured beaks. This was the case with the specimens used in these experiments. Four black Barbs were obtained; those used in Exps. 1 and 34 were bought through a poultry advertising paper, and their origin is unknown. Barb ♀, No. 7, used in Exp. 2, was obtained from Mr. J. Wilkins of Swindon. This

bird was bred from blacks only for five or six generations. In the F. 2 generation from this bird crossed with a white Fantail red birds were obtained, and it is quite possible that this colour figured in the ancestry of the Barb ♀, as breeders are in the habit of crossing blacks with reds in order to obtain white beaks on the blacks. Barb ♂, No. 100, used in Exp. 27, was obtained from Mr. Edwards of Exeter. This bird is believed to have been bred from blacks for four generations, but in the preceding generation a dun ♀ was used. It will be noticed that in Exp. 27, a dun was produced.

The Fantail Pigeon. (Trembleur.)

This variety is well-known on account of the large number of its tail-feathers; specimens having as many as 42 tail-feathers having been observed. This character has been noted in the crosses, and further experiments are still in progress. It is intended that this should be dealt with later in a separate communication. By far the largest number of Fantails are white, and only white birds have been used in these matings. Blue and silver Fantails, both having wing- and tail-bars, are bred by fanciers, as well as self-coloured blacks, reds, yellows, and duns. There are further certain birds possessing well-defined patterns of which the "saddle-back" is the best known.

It is stated by breeders that deep rich blacks are difficult to obtain, owing, no doubt, to the frequent crossing with blues. The irides of the white birds are black, those of the coloured birds either white or orange. The whites have also white beaks and claws, and flesh-coloured ceres or eye-wattles. The Fantail exhibits a curious jerking or twitching movement of the neck; this habit has been noticed in certain of the crossbreds, but no attempt has been made to trace it through the successive generations. During the experiments a small strain of white Fantails was kept, the original birds being obtained as follows:—

From Mr. J. Harrison of Belper, Derbyshire, a judge of pigeons and breeder of several varieties, 1 ♀ and 1 ♂.

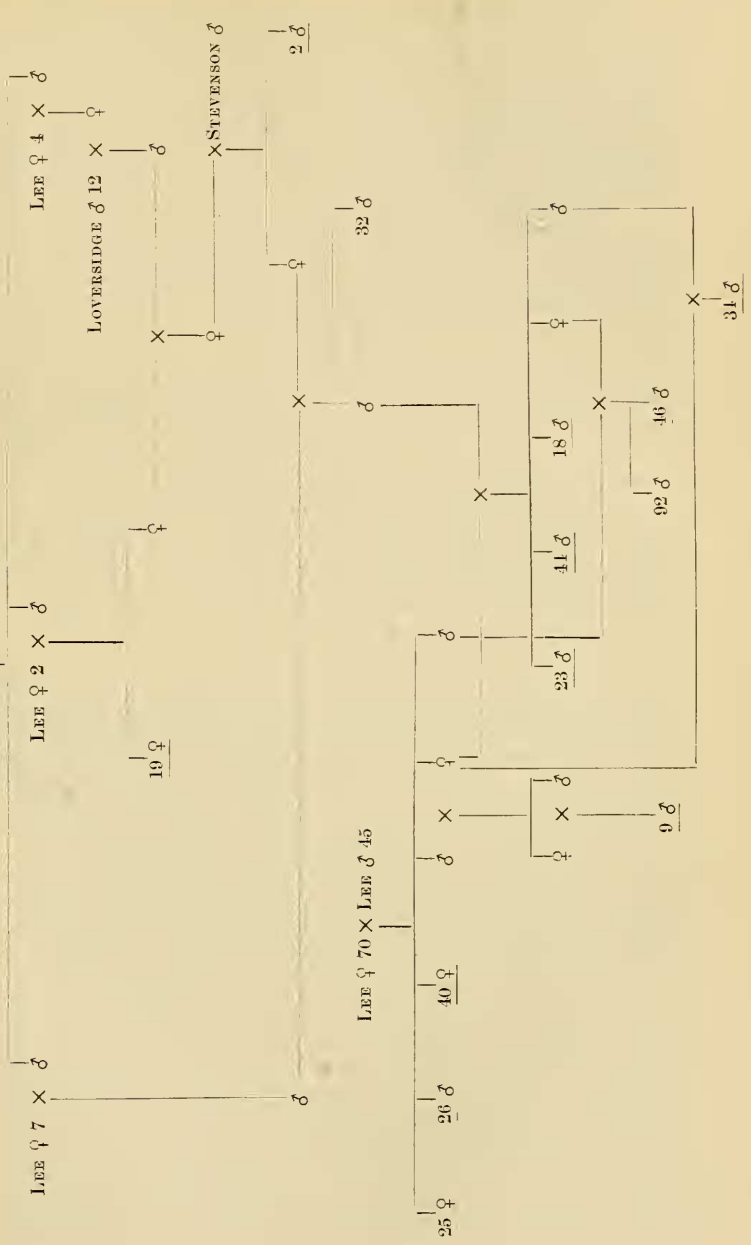
From Mr. J. Lee of Ilford, Essex, 4 ♀'s and 1 ♂.

From the late Mr. J. F. Loversidge of Newark, 1 ♂.

From Mr. W. Stevenson of Beith, N.B., 1 ♂. The three latter gentlemen are well-known breeders of Fantails.

From the various matings of these birds twelve Fantails used in the crosses were raised. The appended pedigree, in which the birds used are numbered and underlined, shows their mutual relationships. Lee ♀ 7 was peculiar in the fact that at the moult following its purchase a black tail-feather made its appearance. At the various successive moults the replacing feather in that position was always black. Although several white Fantails were bred in this strain no bird was produced showing any colour in the plumage. The colours of the irides, beaks, claws, and eye-wattles were also observed to breed true.

Pedigree of Fantails used in Experiments.



Types of Birds produced in the Barb-Fantail Cross.

The birds produced in this cross fell naturally into five classes—black, blue, dun, red, and white. Of these the black, blue, and white are chiefly dealt with in the present paper.

Coloured birds are divided into two classes; those with some white feathers in the plumage, and those without white. The white birds are similarly divided into those having some coloured feathers, and those with none.

It was possible to see to which type a bird belonged at an early age.

The descriptions of the types which follow include the more striking variations noticed in individuals.

1. *Blacks.*

The blacks produced in these crosses were generally of a rich deep colour similar in all respects to that found in the Barb. They possessed the green and purple iridescence on the neck which is commonly seen in all dark types of domestic pigeons. There were, however, certain birds produced, which are specially noted in Exps. 27 and 32, bred from the mating of black and blue, which were of a smoky or sooty black colour. In some of these birds wing-bars of a darker shade of black were observed. The tail-bar was observed on one specimen only.

2. *Blues.*

The birds classed as blue in the following experiments were not identical with *Columba livia*, as were the birds, produced by Darwin, referred to in the introduction. Their general colour was a smoky black with blue tail and black tail-bar. Laying aside the details of the distribution of white when present, which is dealt with below, the series of blue birds produced was very uniform in type. Slight variations occurred in the shade of the blue colour, and the substitution of chequered feathers (*i. e.* blue feathers edged with a variable amount of black) for the smoky black of the wing-coverts. These points were not very distinctive: they are, however, noted under the experiments in which they occurred. The head and upper part of the neck were generally bluish, slightly darker than in *C. livia*, but varying to a smoky black. The lower part of the neck, upper part of the back, wings, and upper part of the breast smoky black. The wing-bars were generally obscured, but in some specimens could be distinguished. The lower part of the breast, lower part of the back and abdomen were blue, occasionally with slight chequering.

The rump was blue, sometimes of a lighter shade than that in other parts of the body. The flanks, thighs, vent, upper and under tail-coverts were blue. The tail-feathers were blue with a black bar, which was sometimes terminal, but more usually a

short distance from the end of the tail. There was frequently, but not invariably, a white edging to the outer tail-feathers.

"*Kitiness.*"

This term is used by breeders to express a rustiness or bronzing of the black feathers. It gives to a black feather the appearance of being edged with a reddish tinge. In certain breeds of pigeons, notably the Jacobin, this characteristic persists through life in some individuals. In the majority of cases, however, it is lost either before or at the first moult. In the cross-bred birds produced in these experiments kitiness was observed in many of the young birds. It appeared not only on the blacks but also on the smoky-black parts of the plumage of birds classed as blues. In the case of every bird that was allowed to reach maturity the kitiness disappeared, except in cases where it was present on the flight-feathers. In this situation it was noticed to persist through life. There is, at present, no reason to suppose that kitiness influences inheritance of colour.

3. *Blacks and Blues with some white feathers.*

It is convenient to describe these two types together. They differ from the two preceding types only in being more or less mottled with white. The amount of white varies very greatly. The black colour has never been observed to be of the sooty shade, but always deep as in the Barb. The amount of white present appears to increase with the number of generations from the original cross. With very few exceptions colour has been in excess of white in these birds. The white is found in certain fairly well-defined areas, of which the following is a list arranged roughly in the order of frequency of occurrence.

1. Rump, vent, and thighs.
2. Certain areas on the head, noticeably the occiput and post-orbital regions. The neck. The lower part of the abdomen. Carpal joints. The bastard wings.
3. Primary flight-feathers generally commencing with the most external, and tertiaries immediately over them. Tail-feathers generally commencing with those near the middle, and both upper and upper tail-coverts.
4. Breast, wing-coverts, and scapulars.

Bonhote has shown in the Journ. Linn. Soc. vol. xxix. p. 185, that the presence or absence of colour tends to make its appearance in mammals and birds in certain definite areas, which he has named "*pœcilomeres*," and of which he gives a list in the Proceedings of the IVth International Ornithological Congress. It will be noticed that the positions of the white in these pigeons agree closely with Bonhote's observations.

In the descriptions of the results of matings details of the various markings are given.

4. *Dun.*

One bird of this type was obtained in Exp. 27. The head, neck, back, rump, breast, abdomen and under parts were of a uniform dark dun colour. The wing-coverts were edged with a lighter shade. Wing-bars could not be distinguished. The flight-feathers were lighter than the rest of the plumage. The tail-feathers showed a bar of a darker shade which was conspicuous on handling the bird.

5. *Reds.*

Five red birds were obtained in F. 2 from Experiment 4. The shade varied slightly in the different individuals, in some the colour being much darker than in others. In all the rump, tail-feathers, and both upper and under tail-coverts presented a bluish tinge. This, however, differed in the various specimens. In some there was merely a bluish-red appearance on the rump and tail, in which case the tail-bar appeared to be merely an aggregation of pigment; whilst in others the rump and tail were almost of the same colour as that already described on the "blue" birds. In these latter the tail-bar was well defined and appeared to be of a reddish-yellow colour. White feathers were present in varying amount on all the red birds. The distribution of the white corresponded with that already described for blacks and blues.

6. *Whites.*

The majority of whites produced in these experiments showed no signs of coloured feathers. A few, however, were raised which had a few ticks of colour on the neck or rump. These were either black or red. Full details are given of these birds in the descriptions of the matings from which they were produced.

Details of the Several Matings.

Series A.

F. 1 *Generation.*

Exp. 1.—White Fantail ♀ 19 × Black Barb ♂, no number. Five young birds raised.

Exp. 2.—Black Barb ♀ 7 × White Fantail ♂ 23. Four young birds raised.

The colour of the F. 1 generation raised from the two above experiments was practically uniform. The birds were black with a few white feathers which usually appeared on the rump, vent, and thighs. In only one instance was there any approach to mottling, and in this bird the black was greatly in excess of the white. Birds raised in the two reciprocal experiments were indistinguishable.

Three matings of the F. 1 birds were made, the results of which are shown in Table I. Thirty-four birds of the F. 2 generation were raised.

TABLE I.

Exp. No.	♀	Origin from Exp.	Also used in Exp.	♂	Origin from Exp.	Also used in Exp.	Offspring. Black.	Black w. f.	Blue.	Blue w. f.	Red.	White with some coloured feathers.	White
1.	White Fantail..... 19	—	—	Black Barb (no number).	—	—	—	5	—	—	—	—	—
2.	Black Barb 7	—	—	White Fantail 23	—	—	—	4	—	—	—	—	—
3.	F. 1 Black with some white. 63	1	5, 12 & 39	F. 1 Black with some white. 71	1	38	—	—	2	1	—	—	1
4.	F. 1 Black with some white. 59	2	—	F. 1 Black with some white. 62	2	—	4	6	—	—	5	2	3
5.	F. 1 Black with some white. 63	1	3, 12 & 39	F. 1 Black with some white. 60	2	—	1	4	—	1	—	2	2
6.	F. 2 White 53	3	42	White Fantail..... 9	—	—	—	—	—	—	—	—	4
7.	F. 2 White with few black. 56	5	—	F. 2 White with black patch. 5	5	—	—	—	—	—	—	5	5
8.	F. 2 Black with some white. 106	5	31	F. 2 Black with some white. 6	5	28	2	6	—	3	—	1	2
9.	F. 2 Blue with some white. 51	3	16	F. 2 Blue 1	3	—	—	—	3	6	—	—	—
10.	F. 3 Blue 97	9	28	F. 3 Blue with some white. 51	9	—	—	—	4	2	—	—	—
11.	F. 3 Blue with some white. 52	9	—	F. 3 Blue with some white. 13	9	21 & 31	—	—	—	9	—	—	2
12.	F. 1 Black with some white. 63	1	3, 5 & 39	White Fantail..... 32	—	—	—	2	—	—	—	—	—

F. 2 *Generation.*

As will be seen by the Table no black birds were raised in Exp. 3. This experiment came to an untimely conclusion early in the breeding season owing to the accidental death of the ♂. No other ♂ raised in Exp. 1 was then living. It seems likely, however, that if the mating could have been continued black birds would have appeared. Exp. 4 was continued for two years, and, in addition to the birds included in the table, a young bird was hatched which died in the nest at the age of ten days. It was dark in colour, but whether it would eventually have been black or blue could not at that age be distinguished.

Black birds in the F. 2 generation.—Of the fifteen black birds raised five showed no trace of white, the other ten having some white feathers. Birds entirely black were not tested at this point of the experiment, but in the crosses between Barbs, Fantails, and Nun pigeons it was shown that extracted blacks in F. 2 bred true (*v.* Exps. 40 & 41). Those having white feathers were noticed to show more white than the birds of the F. 1 generation. In addition to having white feathers on the same parts of the body as the preceding generation, these birds frequently showed white on the head and throat, also on the wings, and more especially on the flight-feathers. The black, however, always greatly predominated in the plumage. In one case there were only a very few white feathers on one thigh.

Blue birds in the F. 2 generation.—In addition to the general description of the blue birds already given, it may here be stated that the bird bred in Exp. 5 (No. 19) differed from those in Exp. 3 in having the blue colour much darker. In the young raised from the subsequent matings of the offspring of this bird, the dark blue colour was very marked, so that it was possible to pick them out at sight in an aviary containing many blue birds. This bird showed two white feathers on the rump which were afterwards moulted out. Experiment, however, proved that it did not contain white (*v.* Exp. 13). Of the blue birds raised in Exp. 3 two (Nos. 1 & 14) showed no white, while the third (No. 51) had a few white feathers at the vent. Further matings proved that two of these birds contained white recessive, while the other did not (see Exps. 9, 16, & 30). Of the four F. 2 blues, therefore, two were homozygous to that colour.

Red birds in the F. 2 generation.—A general description of these birds has already been given. It seems desirable to postpone all further details until the investigation is more advanced.

White birds in the F. 2 generation.—Of the ten extracted white birds six showed no coloured feathers, and four showed a little colour. From Exp. 4 two birds with coloured feathers were raised. Of these one (No. 1) showed four or five feathers of a brownish or reddish tinge on the neck, these were afterwards moulted out. The other (No. 15) had the head and throat ticked with some reddish feathers. These birds were not bred from. In Exp. 5 one white bird (No. 5) was produced which

showed a large patch of black feathers about the size of a five-shilling piece at the root of the neck. Another (No. 56) raised in the same experiment had a few feathers on the rump edged with black. These two birds were mated together in Exp. 7.

Testing the extracted Whites in F. 2.

At the time it was considered desirable to test the extracted whites only one was available, viz. that bred in Exp. 3. It was, therefore, mated to a white Fantail.

Exp. 6.—Extracted White ♀ 53 × White Fantail ♂ 9.

Four young were produced, all white with no coloured feathers.

Exp. 7.—White birds with coloured feathers raised in Exp. 5 described above were mated together.

White with black feathers ♀ 56 × White with black patch ♂ 5.

Ten young were raised in this experiment, of which five showed no coloured feathers; one had one black feather on the rump which was afterwards moulted out; two had two feathers on the rump edged with black; and the remaining two had four and five feathers respectively similarly edged with black.

F. 3 *Generation.*

A pair of black birds with some white feathers of the F. 2 generation raised in Exp. 5 were mated together in 1905, and the experiment was repeated in 1907. In the intervening year the birds were used for mating with blues in Exps. 28 & 31.

Exp. 8.—F. 2 Black w. f. ♀ 106 × F. 2 Black w. f. ♂ 6.

This mating gave 2 blacks, 6 blacks with some white feathers, 3 blues with some white feathers, 1 white with some coloured feathers, and 2 whites. Of the blacks with some white feathers, one bird had only one white feather on the rump, another had two white feathers on the thighs and three of the under tail-coverts tipped with white. The remainder had white on the head, neck, rump, vent, thighs, and under tail-coverts; but one bird had in addition 12 white flights, and 11 white tertiaries, while another had some white flights and tertiaries and also 4 white tail-feathers. Of the blues with white feathers, one bird had white on the rump only, the other two having white on the head, neck, rump, vent, and thighs, one of them having in addition three white flights and two white tertiaries. The bird described as white with some coloured feathers had three feathers on the rump tipped with black.

Exp. 9.—F. 2 Blue few white feathers ♀ 51 × F. 2 blue ♂ 1. These birds were raised in Exp. 3.

Nine offspring were reared from this mating, of which three were blue with no white. The six others all showed white feathers, four of them having white on the head and throat, vent, thighs, &c., and some flight-feathers up to the number of ten as

well as two or three tail-feathers and some under tail-coverts. One bird had only two white tail-feathers and some white on the vent. Another (No. 51 F. 3) had only a very few white feathers at the vent. This bird, however, when mated to a blue without white (*v.* Exp. 10) produced young with white feathers. (The matings of these several young are shown in Exps. 10, 11, 14, 15, 17, 18, 21, 27, 28, and 31.)

F. 4 *Generation.*

Exp. 10.—F. 3 Blue ♀ 97 × F. 3 Blue with very few white feathers ♂ 51.

These birds were raised in Exp. 9. Four young were reared from this cross, of which three showed no white feathers, and the fourth had one white flight-feather, and a large patch of white on the vent and left thigh. In addition to these, two young birds were hatched but died at the age of 10 days: on one of these white quills were seen on the abdomen, but on the other no white quills were visible. From the above it appears that the ♀ bird was homozygous in respect of the blue colour, but that the ♂ contained white. Unfortunately the three F. 3 birds which showed no white were all ♀'s.

Exp. 11.—F. 3 Blue w. f. ♀ 52 × F. 3 blue w. f. ♂ 13.

In this experiment two of the birds with white feathers raised in Exp. 9 were mated together. Eleven young were raised, of which 9 were blue with white feathers and 2 were white. Of the blues with white feathers six showed much white; the white being in the same situations as in the F. 3 birds but more extensive. There was much white on the head and neck, the back and breast were in some cases mottled. The flight-feathers were mostly white up to the number of 29, and many tail-feathers up to 18, and several under tail-coverts. The whole appearance presented was a blue bird mottled with white. The other three blues, however, had only a few white feathers.

No. 15, F. 4, had only a few white feathers on the head and a small patch on the abdomen and vent. This bird, however, was subsequently proved to contain white (see Exps. 19 and 22).

No. 22, F. 4, had a small patch on the vent and thighs, two white tail-feathers, and a few under tail-coverts.

No. 76, F. 4, had a small streak of white behind the eyes, and two white feathers at the vent.

It will be noticed that no blues without white were raised in this experiment as was anticipated. This result may be compared with those of Exps. 24, 25, and 26, in which birds raised from the matings of the heterozygotes with whites did not produce the expected number of blues without white when mated together. Matings in the direct line have not been carried beyond this generation.

Series B.

The Crossbreds mated to Whites.

F. 1 × *white*.

Exp. 12.—F. 1 Black w. f. ♀ 63 × White Fantail ♂ 32.

The ♀ 63 was raised in Exp. 1 and is the same bird used in Exps. 3, 5, and 39. In this experiment only two young were raised, both black with white feathers. One (46) had only a few white feathers on the rump, vent, and thighs; the other (47) had in addition to this a few on the head and neck and a few wing- and tail-feathers white. Had this experiment been continued whites would undoubtedly have appeared.

Blues of F. 2, F. 3, *and* F. 4 *mated to whites.*

Experiments 13 to 23 (see Table II.) show the results of mating the blue birds raised in the foregoing experiments to whites. Some of the whites used were pure Fantails, but the results were apparently the same when "extracted" whites were used (Exps. 19, 20, 21, 22).

Exps. 13, 14, and 15 show the result of mating homozygous blues with whites—24 young were raised in these three experiments, all blue with some white feathers.

Exps. 16–23 show the results of mating blues containing white to whites. In all 41 young were raised, of which 13 were blue with white feathers and 28 were white. The expected results from these matings were blues (with white feathers) and whites in equal numbers. The irregular numbers are discussed in detail immediately after the descriptions of the experiments from which they were obtained.

Details of Exps. 13—23.

Exp. 13.—White Fantail ♀ 25 × F. 2 Blue (with 2 white feathers) ♂ 19.

The ♂ has already been described among the blue birds of the F. 2 generation as being of a darker colour than usual, and having two white feathers which were subsequently moulted out. Twelve offspring were reared all blue with some white feathers. The blue colour varied slightly, in some it was of a darker shade than in the father, and in all was darker than in birds raised in the other experiments. The amount of white also varied from a bird having only a few white feathers on the rump, vent, and thighs, to one having white on the head, neck, breast, rump, abdomen, vent, and thighs, as well as several wing-feathers, 10 tail-feathers, and some under tail-coverts. The average amount of white was about midway between these two extremes.

Exp. 14.—F. 3 Blue ♀ 98 × White Fantail ♂ 46.

Exp. 15.—F. 2 Blue ♀ 120 × White Fantail ♂ 26.

The two ♀ birds were raised in Exp. 9. No white feathers were seen. Twelve offspring were raised all blue with white feathers. The blue colour was uniform throughout. In some cases the sooty colour of the wing-coverts was to a slight extent

TABLE II.

Exp. No.	♀		Origin from Exp.	Also used in Exp.	♂		Origin from Exp.	Also used in Exp.	Offspring. Blue w. f.	Offspring. White.
13.	White Fantail	25	—	—	F. 2 Blue with some white	19	5	—	12	—
14.	F. 3 Blue	98	9	27	White Fantail	46	—	—	8	—
15.	F. 3 Blue	120	9	—	White Fantail	26	—	—	4	—
16.	F. 2 Blue with some white	51	3	9	White Fantail	2	—	—	2	4
17.	White Fantail	40	—	—	F. 3 Blue with some white	30	9	—	2	4
18.	F. 3 Blue with some white	14	9	—	White Fantail	44	—	—	2	7
19.	F. 4 Blue with some white	15	11	22 & 29	Extracted white	50	See text.	20 & 22	1	2
20.	F. 4 Blue with some white	9	10	23	Extracted white	50	„	19 & 22	1	2
21.	Extracted white	20	31	—	F. 3 Blue with some white	13	9	11 & 31	3	3
22.	F. 4 Blue with some white	15	11	19 & 29	Extracted white	50	See text.	19 & 20	1	5
23.	F. 4 Blue with some white	9	10	20	White Fantail	34	—	—	1	1

replaced by blue chequered with black. In these cases indication of black wing-bars were seen. The amount of white varied, but was in excess of the amount present in the F. 3 blues with white feathers. The birds were distinctly mottled, and in some cases the amount of white was in excess of the blue. It appeared on the head and neck, the rump, abdomen, vent, and thighs—most of the flight-feathers were white and several of the tail-feathers and under tail-coverts.

Exp. 16.—F. 2 Blue with few white feathers ♀ 51 × White Fantail ♂ 2.

The ♀ was raised in Exp. 3. The result of the mating was 4 whites and 2 blues with white feathers. Of these one (No. 13) had white on the head, rump, vent, and thighs, 6 white flight-feathers and some other wing-feathers. The other (No. 36) had white on the head, throat, rump, vent, and under tail-coverts, 16 white flights and some other wing-feathers, and 5 white tail-feathers. These two birds were mated together in Exp. 26.

Exp. 17.—White Fantail ♀ 40 × F. 3 Blue w. f. ♂ 30.

Exp. 18.—F. 3 Blue w. f. ♀ 14 × White Fantail ♂ 44.

The two blues with white feathers were raised in Exp. 9. Fifiteen young were produced from these two experiments, of which eleven were white and four blue with white feathers. The amount and distribution of white corresponded roughly to the description given of similar birds in Exps. 14 and 15.

Exp. 19.—F. 4 Blue w. f. ♀ 15 × F. 3 Extracted white ♂ 50.

Exp. 20. F. 4 Blue w. f. ♀ 9 × F. 3 as above ♂ 50.

♀ 15 was raised in Exp. 11. ♀ 9 in Exp. 10. The same ♂ 50 was used in the two experiments. This bird was bred from an F. 2 Red and a white Fantail, which mating is not described in the present paper. The result of the two experiments was 4 whites and 2 blues with white feathers. These birds were similar to those bred in Exps. 14, 15, 17, and 18.

Exp. 21.—Extracted white ♀ 20 × F. 3 Blue w. f. ♂ 13.

Exp. 22.—Repetition of Exp. 19.

Exp. 23.—F. 4 Blue w. f. ♀ 9 × White Fantail ♂ 34.

The white ♀ 20 was raised in Exp. 31 from a blue and a black, both containing white. F. 3 ♂ 13 was raised in Exp. 9 and is the same bird that is used in Exp. 11. F. 4 ♀ 9 is the same bird as used in Exp. 20. These three pairs were put up to test further the proportion of blues with white feathers to whites. The young birds were killed as soon as they had feathered sufficiently for their colour to be seen. No details were kept. The blue with some white feathers in Exp. 22 died in the shell a day or two before it would have hatched. No hesitation, however, is felt in recording this bird as blue since it had a black beak. It was found that, although blue birds with white feathers sometimes occur with white beaks, no case has been met with in which white birds had black beaks. In addition to this it was noticed, as the experimenter became more familiar with the appearance of young birds in the nest, that birds which were subsequently coloured

had a darker down than those which became white. In Exp. 23 only two birds were raised; eight other eggs were laid, but proved unfertile. Exps. 21 and 23 produced blues with some white feathers and whites in equal numbers; on the other hand, Exp. 22 produced 1 blue and 5 whites. The result of the three experiments being 5 blues to 9 whites. It may further be noted that when Exp. 22, which is a repetition of Exp. 19, is reckoned with Exp. 19, we get a result of 2 blues to 7 whites, the exact figures found in Exp. 18.

Discussion of Aberrant Results in Exps. 16—23.

The expected result from these matings (DR × R) was an equal number of blues (with white feathers) and whites. The result obtained, however, was 13 blues to 28 whites. It is therefore necessary to analyse the results more closely. The only matings which gave equality were 21 and 23, these gave 3 : 3 and 1 : 1 respectively. The ratio 2 : 4 was obtained in Exps. 16 and 17, and 1 : 2 in Exp. 20. Seeing that the total number of birds produced in each family was small, the divergence of these ratios from the expected equality would not suggest any very marked irregularity. The totals, however, would point to the need for repetition of the experiments with greater numbers. But when we obtain the unlooked for result of 2 : 7 from Exp. 18 and from the birds mated together in Exps. 19 and 22, we are forced to conclude that some definite disturbing factor is present. The following questions suggest themselves. Do the results obtained from reciprocal matings differ? Has the fact of the white parent being a pure Fantail or an "extracted" any bearing on the matter? With regard to the reciprocal matings, only two matings were made (Exps. 17 and 21) in which the ♂ was blue. These gave ratios of 2 : 4 and 3 : 3 respectively. Dividing up our totals according to the nature of the matings, we arrive at the following figures:—When the ♂ was white the offspring produced were 8 blues and 21 whites. When the ♂ was blue the offspring produced were 5 blues and 7 whites. It will be noticed that, although the whites are in excess in both cases, the divergence is much more marked when the ♂ was white. The possibility of this having some influence on the proportions of the offspring cannot at present be disregarded. The behaviour of the pure Fantail and the extracted White appears to be identical. Only two extracteds were used: one of these in Exp. 21 gave a ratio of 3 : 3, the other in the mating used in Exps. 19 and 22 gave 2 : 7, and the same bird mated to another blue ♀ in Exp. 20 gave 1 : 2.

In connection with the excess of white offspring when the ♂ was white, it is perhaps worth recalling that in certain remarkable instances recessive forms appear in F. 1 when a recessive ♂ is used. The best ascertained example of this phenomenon occurs in the Canary. Cinnamon (*i. e.* pink-eyed) ♀ × green (*i. e.* black-eyed) ♂ gives F. 1 all black-eyed; but black-eyed ♀ × pink-eyed ♂ *may* produce some pink-eyed birds, which are said to be always

females. Professor Whitman also informed Mr. Bateson that in certain of his crosses between species of Doves white females may be produced when the father is white, though the reciprocal cross gives all coloured birds.

Unfortunately no sufficient record of the sexes produced in the cases of the Barb-Fantail Crossbred birds was made; and in order to establish a comparison with these other cases, it would be necessary to show that among the whites here produced there was an excess of females.

Results of mating together Blue birds with white feathers, raised in Exps. 13 *and* 16 *respectively.* (See Table III.)

Exp. 24.—Blue w. f. ♀ 5 × Blue w. f. ♂ 4.

Exp. 25.—Blue w. f. ♀ 10 × Blue w. f. ♂ 11.

These four birds were raised in Exp. 13. The results of the matings were 6 blues with white feathers and 2 whites. No blue birds without white feathers were raised (*cf.* Exp. 11). One of the birds (48), however, had only a few white feathers on the rump, vent, and thighs; and another (17) had white in the same position with a few under tail-coverts. The bird having the maximum development of white (55) showed a few white feathers on the head, neck, rump, vent, and a little mottling on the breast, 4 white flights, 4 white tail-feathers, and a few under tail-coverts and other wing-coverts. The amount of white in this bird is not so much as in the bird showing the maximum development of white in Exp. 13. In addition to the birds included in the Table a bird was hatched in Exp. 24 which died in the nest when very young. It was of a distinct reddish tinge with some white feathers, having tail and flights "blackish." It is probable that this was "kitiness" (*v. ante*), and the bird would have eventually been blue with white. Only two birds were raised from Exp. 25. These were blue with some white feathers. There is no doubt however that, had the mating been continued, white birds would have appeared as in Exp. 25.

Table III.

Exp. No.	♀		Origin from Exp.	♂		Origin from Exp.	Offspring.		
							Blue.	Blue w. f.	White.
24.	Blue with some white	5	13	Blue with some white	4	13	—	4	2
25.	Blue with some white	10	13	Blue with some white	11	13	—	2	—
26.	Blue with some white	36	16	Blue with some white	13	16	1	5	4

Exp. 26.—Blue w. f. ♀ 36 × Blue w. f. ♂ 13. Both these birds were raised in Exp. 16.

Of the offspring 4 were white. One (69) was the blue form without any white feathers. This is the *only* blue bird without white feathers raised from the mating of two blues with white. Five were blue with white feathers, and of these one (75) had only 4 white feathers on the head, a very few on the thighs, and a few white under tail-coverts. Another (78) had a few on the rump, vent, and thighs, and some under tail-coverts. The other three showed more white than those described in Exps. 24 & 25; one of them having 12 and another 11 white flights as well as some white wing-feathers over them, whilst the third had 17 out of 21 tail-feathers white, in addition to the white on the head, neck, rump, vent, thighs, and under tail-coverts.

Series C.

Blues mated to Blacks.

Four different kinds of matings were made of blues and blacks. Birds which did not contain white and also those in which white was carried were used. For results of the matings see Table IV.

Details of Exps. 27—31.

Exp. 27.—F. 3 Blue ♀ 98 × Black Barb ♂ 100.

The ♀ had no white feathers, and had previously been shown not to contain white (*v.* Exp. 14). The ♂ was received from Mr. Edwards of Exeter, who said that he believed it to have been bred from blacks for four generations and before that from a dun ♀. The result of the mating was 8 blacks and 1 dun. No white feathers were seen on any of the young birds. Very slight indications of wing-bars were noticeable on some of the blacks, the ground-colour being rather more sooty or smoky than in the birds previously described, and so causing the bars to stand out as a dead black. These bars were much more conspicuous in the next generation (*v.* Exp. 32). In the Dun (*v. ante*) the tail-bar was very obvious, being of a much darker shade than the ground-colour. This bird was not bred from.

Exp. 28.—F. 3 Blue ♀ 97 × F. 3 Black w. f. ♂ 6.

The ♀ 97 had no white feathers, and as already shown in Exp. 10, when mated to a blue with white feathers gave blues and blues with white feathers only.

The ♂ 6 had white feathers, and has been shown (Exp. 8) to contain white.

The result gave 9 young, of which 5 were black and 4 blue. Of the blacks three had some white feathers and two had not, and of the blues two had white feathers and two had not. One of the blues with white feathers died when a fortnight old, and only one white feather could then be seen. The amount of white in the birds showing this character varied very considerably.

TABLE IV.

Exp. No.	♀	Origin from Exp.	Also used in Exp.	♂	Origin from Exp.	Also used in Exp.	Offspring. Black.	Black w. f.	Blue.	Blue w. f.	Dun.	White
27.	F. 3 Blue 98	9	14	Black Barb 100	—	—	8	—	—	—	1	—
28.	F. 3 Blue 97	9	10	F. 2 Black with some white ... 6	5	8	2	3	2	2	—	—
29.	F. 4 Blue with some white ... 15	11	19 & 22	F. 3 Black..... 109	8	—	2	2	4	—	—	—
30.	F. 2 Blue 14	3	—	Black with some white 46	12	—	1	—	4	2	—	3
31.	F. 2 Black with some white ... 106	5	8	F. 3 Blue with some white ... 13	9	11 & 21	1	—	1	1	—	4
32.	Black..... 12	27	—	Black 1	27	—	7	—	1	—	—	—
33.	Blue (chequered) 99	30	—	Blue (chequered) w. some white 16	20	—	—	—	4	2	—	—

Exp. 29.—F. 4 Blue w. f. ♀ 15 × F. 3 Black ♂ 109.

The ♀ 15 was raised in Exp. 11, and had previously been shown to contain white (*v.* Exps. 19 & 22).

The ♂ 109, raised in Exp. 8, was black with no white. This bird had not been previously bred from, but seeing that no whites were produced in this experiment we may conclude that it did not contain white.

The result of the mating gave 8 young, of which 4 were black and 4 blue. Of the blacks two (Nos. 50 & 65) showed very few white feathers at the vent. No white was seen anywhere else on the plumage. Another black bird (No. 49) was rather light or sooty in colour, as already described in Exp. 27, and very slight indications of a tail-bar were noticed. None of the blue birds showed any white.

Exp. 30.—F. 2 Blue ♀ 14 × Black w. f. ♂ 46.

Exp. 31.—F. 2 Black w. f. ♀ 106 × F. 3 Blue w. f. ♂ 13.

The ♀ 14 was raised in Exp. 3. The ♂ 46 was raised in Exp. 12 from F. 1 × white. Neither of these birds had been previously bred from. This experiment, however, showed that they both contained white.

The ♀ 106 was raised in Exp. 5, and has been shown in Exp. 8 to contain white. The ♂ 13 was raised in Exp. 9, and was shown in Exp. 11 to contain white. The total result of the two matings was 2 Blacks, 5 Blues, 3 Blues with white feathers, and 7 Whites. The blues from both matings were lighter in colour than in the preceding experiments, the sooty colour of the wings being of a much bluer shade than in the typical blue, and in some cases being replaced by blue chequered with black. The wing-bars were very distinct. Where white feathers were present they were very few in number and were confined to the rump, vent, and thighs.

Results of mating together Blacks from Exp. 27 *and Blues from Exp.* 30 *respectively.*

Exp. 32.—Black ♀ 12 × Black ♂ 1.

These two birds were raised in Exp. 27, and both were without any white feathers. The plumage of both was somewhat smoky, and slight traces of wing-bars could be discerned. From this mating 12 birds were hatched. Of these, however, 4 died under the age of one week. The colour of the plumage could not be ascertained. The 8 birds reared consisted of 7 blacks and 1 blue. Of the blacks, one is of a deep rich plumage showing no traces of bars. Four are of a sooty-black colour with the wing-bars very distinct. In one of these a tail-bar is also seen. The remainder are sooty-black with no, or very slight, indications of bars. It is most probable that, if these birds were bred from, the sooty-coloured specimens with wing-bars would be shown to contain blue, whilst the deep black with no traces of wing-bars would prove to be homozygous.

Exp. 33.—Blue chequered black ♀ 99 × Blue chequered black with few white feathers ♂ 16.

These two birds raised in Exp. 30 were selected as showing the lightest type with chequering. The wing-bars were very distinct. ♂ 16 had a few white feathers at the vent.

The mating produced six birds all of the chequered type with clearly defined wing-bars. Of these four showed no white, and the other two had a very few white feathers.

Barb-Nun Cross.

In this cross three matings only were made, and twenty-eight young produced. The experiment was originally started, as stated in the introduction, in order to cross the F. 1 Barb-Nun generation with the F. 1 Barb-Fantail. Some further matings were, however, made in order to investigate the inheritance of the "shell" (*v. infra*), the results of which, together with some other crosses in experiments on the same character, are described in P. Z. S. 1905, vol. ii. p. 550. The Black Barb ♂ used in this mating was obtained through the medium of a Poultry advertising paper, and no details of its pedigree were obtainable. This bird had white irides, the beak white tipped with black, the claws white, the eye-wattles bright red.

The Nun Pigeon. (Pigeon Coquille Hollandais.)

A curious structural character presented by this bird is the "shell," which is a tuft of reversed feathers standing up at the back of the head, having an appearance somewhat like that of a cockle-shell. After this point, attention is paid by breeders to its colour and markings. It is a white bird with certain coloured markings forming a very definite pattern. The markings are found in several colours, of which black, blue, dun, red, and yellow are the chief. By far the greatest number are black, and this was the colour of the ♀ used in these experiments. The head, as far back as the "shell," is black, but the coloured feathers do not extend into the shell. The chin and throat are black, forming what is known as the "bib." Ten outer flight-feathers on each wing should be black; in the specimen used, however, there were only seven black flights in one wing and eight in the other. There were also two black secondaries and two black tertiaries, as well as a few black feathers at the carpal joints. The tail is black, as also are the upper and under tail-coverts. These markings should be very definite or "clean cut," and there should be no black on any other part of the plumage. The ♀ used, however, had two black feathers on the back. The black in the bird used was not a deep rich colour, as is found in the Barb; and it is stated by breeders that many Black Nuns are found whose colour is rather smoky. This was noticed in some of the offspring of the cross. The irides are white, and there appears to be no difficulty in breeding this character true in this

variety of pigeon. In the Black Nun the cere or eye-wattle is blackish as are also the beak and claws. No details of the ancestry of the ♀ Nun were obtained. The variety breeds true to the markings and no self-coloured birds or whites are produced.

Cross-bred Birds.

Although this experiment was taken as far as the F. 2 generation, no blue birds were produced. The numbers, however, are small, and it is possible that in further matings they might have appeared. Blacks were raised in F. 2, but for want of space were not tested. Three birds also appeared in F. 2 which resembled the Nun in markings, these are alluded to in Table V. as "white with a few black feathers." These birds were not bred from. The remaining birds were classed in three divisions as, "blacks with a few white feathers," "mottled, with black in excess," and "mottled, with white in excess." This classification, although useful for purposes of description, is purely arbitrary, and no suggestion is made that the birds differed gametically. It was very noticeable that in the mottled birds the markings of the Nun were present, and in addition black mottling occurred on those parts of the plumage which are white in the Nun. Full descriptions of the cross-bred birds are given in the details of the experiments. There appears to be no correlation between the presence of a shell and the Nun markings.

Details of the Matings.

F. 1 *Generation.*

Exp. 34.—Nun ♀ (no number) × Black Barb ♂ (no number).

These birds were mated together for two years and twelve young were produced. All were black with white feathers and in all the black was in excess of the white. Two distinct types of birds, however, were produced. One class consisted of black birds with a few white feathers which appeared usually on the rump, vent, and thighs, and on the neck or breast sometimes in the position of the junction of the white of the breast with the black of the "bib," as described in the Nun pigeon. Seven of the F. 1 birds were of this type. In the other class, of which there were five, the birds presented a more mottled appearance, black however being in excess. The head, bib, and tail were always black. The flight-feathers black with the exception of one or two, the rump frequently white. The back and wing-coverts black mottled with some white, the breast and abdomen white mottled with some black feathers.

F. 2 *Generation.*

Exp. 35.—F. 1 Black with few white feathers ♀ 8 × F. 1 Black with few white feathers ♂ 54.

Both these birds were raised in Exp. 34 and were of the first

TABLE V.

Exp. No.	Parentage.	♀	Origin from Exp.	Also used in Exp.	Parentage.	♂	Origin from Exp.	Also used in Exp.	Offspring. Black.	Black with few white feathers.	Mottled. Black in excess.	Mottled. White in excess.	White with few black feathers.
34.		Nun ..... (no number)	—	—		Black Barb ... (no number)	—	—	—	7	5	—	—
35.	N×B	Black with few white ... 8	34	38	N×B	Black with few white ... 54	34	39	—	2	—	1	—
36.	N×B	Black mottled with white. 1	34	—	N×B	Black mottled with white. 3	34	—	2	5	3	—	3
37.	N×B	Black with few white ... 18	34	—	F×B	Black with few white ... 68	1	—	1	3	2	1	1
38.	N×B	Black with few white ... 8	34	35	F×B	Black with few white ... 71	1	3	2	2	—	1	—
39.	F×B	Black with few white ... 63	1	3, 5, & 12	N×B	Black with few white ... 54	34	35	2	2	1	2	—
40.	BF×BN	Black 53	38	—	BF×BN	Black 45	39	41 & 42	5	—	—	—	—
41.	BF×BN	Black 65	37	—	BF×BN	Black 45	39	40 & 42	4	—	—	—	—
42.	BF×BF	White 53	3	6	BF×BN	Black 45	39	40 & 41	1	4	2	—	—

type described. They were mated together late in the breeding-season, having both been previously used to cross with Barb-Fantail F. 1 crosses (*v.* Exps. 38 & 39).

Three young only were produced, of which one was black and white mottled with the white in excess. Unfortunately no details of the markings of this bird were kept. The other two were black with a few white feathers on the abdomen, and on the rump in one of them.

Exp. 36.—F. 1 Black mottled with white ♀ 1 × Black mottled with white ♂ 3.

These two birds raised in Exp. 34 were of the second type described.

Thirteen young were produced :—

Black 2.
F. 1 types 8.
Birds resembling Nun 3.

Of the F. 1 types 5 were black with a few white feathers and 3 black mottled with white. Two of these, recorded as belonging to the first type, died when about a week old in the nest. The others showed only a few white feathers on the abdomen, rump, and vent, and one had three white flight-feathers and a few other white feathers on the wings.

In those recorded as mottled the black was distinctly in excess in one case, and in the other two birds the amount of black and white was about equal. The head, "bib," and tail were black in all cases, and several of the flight-feathers were black. Roughly speaking, the back and wing-coverts showed more black feathers than the breast, abdomen, and under parts. In one case (No. 17) the feathers on the back of the neck and the right wing-coverts were black edged with white, giving a "pepper and salt" appearance to those parts. This peculiarity has not been noticed in any other bird. The following are the details of the markings of the three birds whose plumage somewhat resembled that of the Nun pigeon :—

No. 7. White. Tail black. 2 black flights. A few black feathers on the head. 4 black wing-coverts and one black feather on the breast. The total amount of black was less than in the Nun.

No. 11. White. Tail black. 7 black flights. A few black feathers on the head. The wing-coverts were slightly mottled, the greatest amount of black being in the scapular region. A few black feathers on the breast and rump.

No. 14. White. Tail black. 8 black flights. A few black feathers on the head and at the carpal joint. In this bird again the amount of black is less than in the Nun.

Barb-Fantail-Nun Cross.

In this small series of experiments the F. 1 Barb-Fantails were mated to the F. 1 Barb-Nuns. No reversionary blues appeared. The forms produced are scheduled in Table V. Some were definitely black, and the remainder showed combinations of black and white in various proportions. The composition of these latter was not investigated further, but it may be noted that one bird (No. 70) agreed exactly with the F. 1 Nun-Fantails described below. As would be expected, no whites appeared.

The further matings show that the extracted blacks in F. 2 breed true. No blues were produced; and the black colour was rich and deep in hue, so that no indications of wing- or tail-bars were discernible.

An extracted black mated in Exp. 42 to an extracted white from the Barb-Fantail Experiment gave offspring which were indistinguishable from those produced in F. 1 from a black Barb and a white Fantail.

F. 1 *Barb-Fantails mated to* F. 1 *Barb-Nuns.*

Exp. 37.—F. 1 Barb-Nun ♀ 18 × F. 1 Barb-Fantail ♂ 68.
Exp. 38.—F. 1 Barb-Nun ♀ 8 × F. 1 Barb-Fantail ♂ 71.
Exp. 39.—F. 1 Barb-Fantail ♀ 63 × F. 1 Barb-Nun ♂ 54.

All these birds were black with a few white feathers. The Barb-Fantails were raised in Exp. 1, the Barb-Nuns in Exp. 34. The Barb-Fantails 63 & 71 are the same as used in Exp. 3, and the Barb-Nuns 8 & 54 are those mated together in Exp. 35.

From the three matings twenty young were produced:—

5 Blacks.
7 Black with few white feathers.
7 Mottled.
1 White with a few black feathers in the tail (No. 70).

The notes on the details of the markings of these birds are unfortunately very scanty. In the blacks with a few white feathers the white appeared, when it was noted, on the rump and vent. In one case there was a white flight, and in another there were a few white tail-feathers. Of the seven mottled birds three are recorded as having the white in excess of the black. It was noted that the tail was black in the mottled birds, one bird, however, had one white tail-feather. The head was generally black; the flight-feathers varied, in some cases being all white, and in others mostly black.

Testing the Extracted Blacks from the three foregoing Experiments.

Exp. 40.—Black BF. BN ♀ 53 × Black BF. BN ♂ 45.
Exp. 41.—Black BF. BN ♀ 65 × Black BF. BN ♂ 45.

♀ 53 was raised in Exp. 38, ♀ 65 in Exp. 37, and ♂ 45 (used in both matings) in Exp. 39.

Nine young birds were produced, all being black.

Extracted Black mated to Extracted White.

Exp. 42.—F. 2 Barb-Fantail White ♀ 53 × Black BF. BN ♂ 45.

The extracted White in F. 2 of the Barb-Fantail experiments was raised in Exp. 3, and has in Exp. 6 been shown to breed true to white with a White Fantail. The extracted Black BF. BN is the same used in the two preceding experiments. Seven young were produced, one of which was black without white; the rest were black showing white feathers varying in amount from a small patch on the vent to a distinct mottling. In all cases, however, the amount of black was in excess of the white.

Nun-Fantail Crossbreds.

No crosses were made in these experiments between the Nun and the Fantail. Through the kindness of Miss Thiselton-Dyer, however, two ♀ birds were received, the result of such a cross. For the purpose of comparison with the birds produced in the Barb-Fantail-Nun experiment a description of them is given. These birds were white with some black feathers in the tails. One had a tail consisting of fourteen feathers of which five were black. The other had eleven tail-feathers of which three were black. A few of the upper tail-coverts were also black in each bird, but beyond these the plumage was quite white. The irides were black, the beak and claws white, and the eye-wattle or cere flesh-colour, slightly reddish in one. In view of the recessive behaviour of the white from White Fantail elsewhere, it is perhaps remarkable that these birds showed so little colour.

White Tumbler-White Fantail Cross.

This cross was made between two white strains of different varieties of pigeons. The Tumbler was of a white strain which is described below. The Fantail used was from the strain kept and already described. Only four matings were made and the experiment carried to the F. 3 generation, and only thirty-six birds were produced. The numbers are scarcely sufficient to give any quantitative results. It was, however, found that colour was produced in the F. 1 generation, and the reversionary blue appeared in F. 2 in conjunction with red and white. These birds are described as Tricolors. Further, in F. 3 a bird was obtained having one blue tail-feather with the terminal black bar.

The appearance of some coloured birds from these matings suggests the possibility that in the White Tumbler a dominant white factor, comparable with that known in fowls, may exist.

White Tumbler Pigeon. (Culbutant.)

Nearly every variety of colour, shade, and marking existing in domestic pigeons is found in the Tumbler. There are a few strains

of whites. The ♀ bird used in this cross was obtained from Mr. G. S. Fayle of Birr, King's Co. It was white without any trace of coloured feathers, having the iris white, or "pearl." It was also "long-faced" and "clean legged," *i. e.* free from feathering. Mr. Fayle very kindly gave the following details of his experience in breeding the strain, which has been in his possession for over twenty years. The greatest difficulty in breeding these birds is to obtain a white pigeon having a white eye, as there is a very great tendency for white birds to have dark eyes (*v. infra*). If, however, one or two coloured feathers are present in the plumage the correct eye-colour is more easily produced. Breeders are therefore in the habit of occasionally introducing into their strain a splashed bird in order to improve the eye-colour. Mr. Fayle introduced two hens splashed with red about fifteen years ago, and used them for one breeding-season only. Since then he has never introduced any bird that to his knowledge was bred from other than white parents. He believes, however, that there is hardly a strain of white Tumblers in existence into which splashed birds have not, at some period, been introduced. It was found that the strain occasionally produced birds having a few coloured feathers, seldom more than two or three, which were either black or red. These usually appeared on the head or neck, and sometimes a secondary wing-feather might be tipped with colour. These coloured feathers were frequently not reproduced at the moult. Birds showing these coloured feathers were never selected for breeding. It was further noted that there was a greater tendency for birds having the desired white eye to produce splashed offspring than those having part or the whole of the eye dark. The eye-wattle is white as are also the beak and claws.

Types of Cross-bred Birds produced.

The birds produced from this series of experiments fell naturally into the three classes of whites, whites with a few coloured feathers or "splashes," and "Tricolors." If a larger number of birds had been produced, it is possible that there might have been some overlapping between the two latter classes.

1. *Whites.*

In every mating of this series of experiments whites have been produced. The number of whites bred was 17; and of the birds showing coloured feathers 19. Owing to limitation of space, extracted whites were not mated together.

2. *Whites with a few coloured feathers.*

The number of coloured feathers on birds described under this class was very small, varying from two isolated feathers to a small patch of about a dozen. In no case was there any approach to mottling. The coloured feathers were in most cases on the neck

or scapular region, and occasionally on the rump or tail. The colour generally found was red, but black, bluish black, and blue were seen. In the few cases in which birds were kept a second year, it was seen that the coloured feathers in one case did not reappear after the moult, and there was also one instance of red feathers being replaced by blackish ones.

3. "*Tricolor type.*"

In the F. 2 and F. 3 generations birds were produced which were red and white with some blue feathers. With one outstanding exception (F. 3; 9) birds of this type were fairly uniform in marking. The head and upper part of the neck and throat were white slightly mottled with red. Lower down, especially on the back and sides of the neck, the amount of red increased gradually, and at the root of the neck there were no white feathers. The upper part of the breast was red with a slight bluish tinge between the red and the white of the lower part of the breast and abdomen, on which there were no coloured feathers. Here the line of demarcation between the colour and the white was very distinct and "clean cut." The upper part of the back and scapulars was red, generally of a lighter shade, and resolving itself into a mere powdering, or the "strawberry" shade of the fancier. This was continued slightly on to the proximal wing-coverts where there was mottling with white. The external wing-coverts and all the flight-feathers were white. The lower part of the back below the origin of the wings was white. The rump was light blue, the shafts of the feathers being black. This colour was carried on to the upper tail-coverts. The tail-feathers were generally white, but in two cases some of the external feathers showed a slight blue tinge with the shafts black. Very slight indications of a terminal bar could be made out, especially when the tail was viewed from the under surface. In most cases one or both flanks were blue, the colour being carried down onto the thighs. The rest of the under surface was white.

Details of the Matings.

Colour.

The details which follow relate to the successive matings and to the young produced respectively from them. The results are also given in tabular form in Table VI.

F. 1 *Generation.*

Exp. 43.—White Tumbler ♀ 9 × White Fantail ♂ 18.

Nine young were produced of which six were white, and three showed a very few coloured feathers, as follows:—

No. 1. Two red feathers on the neck which were afterwards moulted out.

No. 5. A few feathers tinged red on the right scapular region. This bird changed slightly during the moult. It then had four blackish tinged feathers on the right scapular region, the red colour having disappeared.

No. 7. Also had a few feathers tinged red on the scapular region.

TABLE VI.

Exp. No.	♀	Origin from Exp.	♂	Origin from Exp.	Offspring. White	Offspring. White with few coloured feathers.	Offspring. Tri-color.
43.	White Tumbler 9	—	White Fantail 18	—	6	3	—
44.	F. 1 White with few coloured fthrs. 5	43	F. 1 White with few coloured fthrs. 1	43	4	4	2
45.	F. 2 White with few coloured fthrs. 13	44	F. 2 White with few coloured fthrs. 15	44	4	5	—
46.	F. 2 Tricolor 7	44	F. 2 Tricolor 8	44	3	—	5

F. 2 *Generation.*

EXP. 44.—F. 1 White with few coloured feathers ♀ 5
× F. 1 White with few coloured feathers ♂ 1.

These birds, raised in Exp. 43, are described above. Ten young were produced, of which four were white, and six showed some coloured feathers. These latter were divisible into two groups: one, of which there were four birds produced, was white with a few coloured feathers as in the F. 1 generation; the other, of which two birds were produced, was of the tricolor type, previously described. Of the whites with a few coloured feathers, No. 13 had one feather showing both red and black on the right scapular, and one black feather on the rump.

No. 14 had two black feathers on the neck and one on the back.

No. 15 had two red feathers on the neck and three on the right scapulars.

No. 18 had several red feathers on the scapulars.

The details of the two birds recorded as tricolors (Nos. 7 and 8) coincide very closely with the description of the type already given.

F. 3 *Generation.*

Exp. 45.—F. 2 White with few coloured feathers ♀ 13 × F. 2 White with few coloured feathers ♂ 15.

These birds, raised in Exp. 44 and described above, produced nine offspring when mated together, four of which were white, and five white with some coloured feathers. Of those in the latter class four showed a few red feathers on the back of the neck, and in one instance on the left scapular. No black or blue feathers were seen on these birds. The fifth (No. 112), however, had no coloured feathers on the neck, but on the right wing-coverts was a large patch of feathers tinged red and edged with black, also one tail-feather blue with a terminal bar, the rest of the tail and plumage being white.

Exp. 46.—F. 2 Tricolor ♀ 7 × F. 2 Tricolor ♂ 8.

These two birds raised in Exp. 44, and of the type described, produced eight offspring, three of which were white and five tricolors. The details of four of the tricolors approximate closely to the type. In two of them blue was present on the breast, flanks, and rump. On one it was present on the flanks only, and in another there were only slight indications of blue on the rump. In the bird showing most blue there was a slight blue tinge on some of the tail-feathers. The fifth coloured bird (No. 9), produced from this mating, showed, in addition to the typical red on the neck and breast, a large amount of bluish-black colour. The left scapulars and proximal wing-coverts were light reddish feathers edged with black, and blue feathers chequered with black were interspersed among them. The right scapulars were blue chequered with black. The remainder of the plumage, including the under parts, was white with the exception of a single blue feather on the rump.

Irides.

The irides of pigeons are chiefly of three colours, white, orange, and black. On each the blood-vessels of the iris can be seen very distinctly and, in some cases, give a very well-marked red appearance most noticeable at the periphery.

The white, or, as it is called by fanciers, the "pearl" eye breeds true in many varieties of pigeons, but in some it is apt to throw orange- and black-eyed birds. The latter is stated to be more easily "bred out" from a strain than the former. The orange iris is found in *Columba livia*, and appears to breed true in several fancy varieties. The black iris (termed by fanciers "hazel" or "bull" eye, which is, more correctly speaking, a brownish-black), seems to breed true invariably. In the nest the irides of all the young pigeons examined were black, but in birds in which this was not the eye-colour of the adult, the colour

changed to white or orange usually within two months after hatching. In the foregoing experiments no matings were made specially to test the inheritance of the colour of the iris, and this character has only been studied incidentally. From lack of space it was found necessary to kill many of the young birds before the colour of the iris in the adult state could be noted; and in the earliest experiments no notes were taken of the minor characters presented.

Some few cases were met with in which the colour of the iris did not completely change, but a small segment of one iris remained permanently black, or the greater part of both irides was black and only a small part showed white or orange. One bird was bred having one iris black and the other orange, but this appeared to be a very exceptional case.

The Barb pigeon has generally a white eye, although black Barbs are sometimes seen with orange eyes. White Barbs have been seen with white eyes, but nearly always have black. Of the four black Barbs used, those in Exps. 2, 27, and 34 had white irides. That used in Exp. 1 is believed to have had an orange iris, the notes of this experiment referring to plumage colour only. The white Fantails had black irides; coloured Fantails, on the other hand, have either white or orange. The black and white Nun had white irides. The white Tumbler also had white irides; this character has been specially referred to in the description of the Tumbler.

In the four series of experiments irides were obtained as follows:—

Barb-Fantail Cross gave white, orange, and black.

Barb-Nun Cross gave white only.

Barb-Fantail-Nun Cross gave white, orange, and black.

Fantail-Tumbler Cross gave black only.

There appears to be a very distinct association between white plumage and black iris, and, in a lesser degree, between black plumage and white iris, as the following tables show (p. 100). Here the birds are grouped irrespective of the generations to which they belong.

In the case of the blue birds with some white feathers there appeared to be a general, though not invariable, rule that the birds showing the greatest amount of white had black irides and those with fewer white feathers orange irides.

The tables show very conclusively the relation between the white plumage and black irides. This correlation extends to the whites with some coloured feathers, and even to the mottled birds in which white is in excess. It is further seen that no black bird has a black iris, and the black iris is also exceptional in black birds with some white feathers. In the Barb-Fantail cross there appears to be a correlation between the white iris and black plumage; the figures, however, of the Barb-Fantail-Nun cross, although small, do not bear this out.

The doubtful record of the iris of the Barb used in Exp. 1, and the absence of notes on the irides in some of the earlier experiments, makes the tracing of inheritance of this character very unsatisfactory.

Barb-Fantail Cross.

	White.	Orange.	Black.
Black	15	1	0
Black with some some white feathers	18	6	2
Blue	9	13	2
Blue with some white feathers	10	20	20
White	0	0	48
White with some coloured feathers	0	0	11
Red	5	0	0
Dun	1	0	0

Barb-Fantail-Nun Cross.

Black	3	9	0
Black with few white feathers	6	3	1
Mottled, black in excess	2	1	0
Mottled, white in excess	0	0	3
White with few coloured feathers	0	0	1

A very clear result is, however, obtained in Exp. 2, which was made later. In this case a Barb with a white iris was mated to a Fantail with a black iris, and the four young produced had white irides. Two of these mated together in Exp. 4 gave 13 birds with white irides, and 4 with black. Three other young were produced, but were killed before the colour of the iris could be ascertained. This, therefore, gives the simple 3 : 1 Mendelian proportion in F. 2, white being dominant.

The remaining crosses, both of the Barb-Fantail and the Barb-Fantail-Nun experiments were, unfortunately, all made with birds descended from the Barb used in Exp. 1.

The results of these experiments are grouped together in the following tables irrespective of the generations to which the birds belonged.

Barb-Fantail Cross.

Colour of irides of parents.	White.	Orange.	Black.
Orange × Orange	0	21	8
Black × Black	0	0	14
White × Black	7	0	2
Orange × Black	4	9	26
White × Orange	25	6	17
Barb-Fantail-Nun Cross.			
White × White	6	0	2
Orange × Orange	2	2	0
Orange × Black	0	3	1
White × Orange	3	8	2

In connection with the above tables it may be noted that in the matings of orange × black irides, the excess of blacks over oranges in the offspring is in some measure associated with the excess of white-plumaged birds over blues in Exps. 16–23 where equality was expected. Further, in the White × Orange experiments, all the offspring from two matings, amounting to 12 birds, had white irides.

The bird already mentioned as having one iris black and the other orange was raised from ♀ with black irides × ♂ with orange. This bird when mated to a bird with black irides gave 5 young all with black irides.

In the Barb-Nun experiment 21 birds were reared to an age at which the adult colouring of the iris showed itself. In all these foregoing birds the irides were white. In the two Nun-Fantails described the irides were black. The Tumbler-Fantail cross is exceedingly interesting in respect of the irides. As has been stated, white irides cannot be kept in a strain of white Tumblers without the occasional introduction of birds having some coloured feathers. In the cross between the white-eyed Tumbler and the black-eyed Fantail, 36 birds were raised. Of these 35 had black irides, and one had a small part of the left iris white, the remainder being black. This was a splashed bird in the F. 2 generation (Exp. 44, No. 14).

The foregoing facts as far as they go suggest the conclusion that the black iris is correlated with the white plumage, and that

possibly there may also be, although in a much lesser degree, some correlation between the white iris and the black plumage. The figures respecting blue birds are not so conclusive, but seeing that the orange iris is the only one found in *C. livia*, the suggestion may be hazarded that there is possibly some correlation between the orange iris and blue plumage. The matter becomes more complex when we study the blue and black birds in the plumage of which white feathers occur. It is, however, suggested that the amount of white present in the plumage may have some influence on the determination of the colour of the iris. Whether the association of certain eye-colours with certain types of plumage-colour arises through gametic coupling or not cannot yet be positively asserted.

With regard to the question of dominance, it has already been shown that white is a simple dominant to black in the case where the record of the irides of the original parents was kept, and a Mendelian ratio of 3 : 1 was obtained in F. 2. In the table of the Barb-Fantail-Nun cross also, a 3 : 1 ratio was given when birds having white irides were mated together. It is further shown that extracted black irides breed true without exception.

Further experiments are necessary before the relation of orange to black, and white to orange can be definitely asserted. It appears probable, however, that black will be eventually found to be recessive to orange, and that orange may be recessive to white.

Beaks and Claws.

In the Barbs used the beaks were either white tipped or tinged with black, or were horn-colour. The claws also were horn-colour. In the white Fantails the beaks and claws were white; they were also white in the white Tumbler, and in the Nun they were black. In the Barb-Fantail and Barb-Nun-Fantail crosses the following types of beaks and claws were met with:—(1) Birds having quite black beaks; in these the claws were usually black, sometimes white, and sometimes mixed, some of the claws of an individual being black and others white. (2) Birds having white beaks with some dark pigment. This might be a white beak tipped with black, or one mandible might be black and the other white, or the beak might be of a general horn-colour. In these birds the claws were usually mixed, but some individuals were produced having all the claws black, white, or horn. (3) Birds having white beaks; these invariably had white claws. [One bird only is recorded as having a white beak and black claws, it was black in plumage, and was killed when only just over a fortnight old. The record is probably erroneous, and had the bird reached maturity it would have been found to have a white beak tipped with black.] There is a very marked correlation between the colour of the beak and claws and that of the plumage. White beaks and claws have been found on every white-plumaged bird bred, also on whites with some coloured feathers, and reds. Black

and Blue birds with or without white feathers, on the other hand, have beaks of types 1 or 2, there being some black present in the beaks. Five exceptions, however, occurred; these were blue birds with a large amount of white in the plumage, having white beaks and claws. In the Barb-Nun cross the beaks and claws of the birds in the F. 1 generation were black. In F. 2 four birds were produced having white beaks tipped with black and some white claws. The remaining birds of the F. 2 generation had beaks and claws black. In the Tumbler-Fantail cross the beaks were white with the exception of a bird in F. 2 (No. 14, Exp. 44), which had the lower mandible tinged blackish. The claws were white throughout. The general conclusion is that pigment in the beak, and to some extent in the claws, is correlated with certain types of plumage. Acting thus it is allelomorphic to white, and is a simple Mendelian dominant.

Eye-wattles or Ceres.

In the Barb the eye-wattle is large. It increases in size with age, and has been seen measuring one inch in diameter. It presents the appearance of a series of naked nodules of skin arranged in two or three concentric rows. In colour it is bright red. In the three other varieties used in these crosses the wattles are very small. In colour those of the white Fantail and white Tumbler are white or pale flesh-coloured, that of the Nun blackish. In size the wattles of the F. 1 generation from a Barb were intermediate; some large wattles were observed in the F. 2 and subsequent generations, but these never assumed the proportions of those of the pure Barb. It was noticed that these large wattles were always red, but they were present on birds having black, blue, or white plumage.

Observations on the colour of the wattles of birds in the Barb-Fantail crosses have been somewhat complicated by the fact that many birds, which were subsequently seen to have red wattles, when young showed wattles of a yellowish colour which were scarcely distinguishable from the flesh-coloured wattles of the Fantail. The general result, however, appears to be that red is a simple dominant over flesh-colour. In the F. 2 generation one blackish wattle was obtained, and some others were found in the further generations. In one experiment birds possessing these wattles were mated together, with the result that offspring showing all these kinds of wattles were produced. Occasionally birds with wattles coloured partly red and partly black, or partly white and partly black, were produced. Whether these wattles would have changed their colour later in life cannot be stated.

The colour of the wattles in the Barb-Nun cross is not very clear. Birds of the F. 1 generation had blackish wattles with, in one or two cases, a little red at the periphery. In F. 2 some birds with red wattles were obtained, two with white wattles, and some with mixed wattles. Little reliance, however, can be placed on

this result as the experiment was very small and the young birds were killed before they reached maturity. In the Barb-Fantail-Nun crosses red, yellow, black, and mixed red and black wattles were obtained. The yellows might possibly have changed to red. No flesh-coloured wattles were recorded. The two Nun-Fantails, however, had flesh-coloured wattles. In the Tumbler-Fantail experiment the wattles were flesh-coloured throughout.

Owing to the various changes occurring in this character during the life of an individual, it is by no means a satisfactory subject for experiment.

Conclusion.

The experiments here recorded have been subsidised by the Government Grant Committee of the Royal Society. The writer is indebted to Mr. J. H. Elwell for much kind assistance.

The matings, throughout, have been made in consultation with Mr. Bateson, who has most kindly supervised the experiments. He has also read the manuscript for the present report, and made many very valuable suggestions and alterations. To him the writer desires to express his sincere thanks.

EXPLANATION OF THE PLATES.

Black Barb–White Fantail experiment.

Plate IV. Fig. 1. Black with some white feathers.
Fig. 2. White with black patch. (Exp. 5.)
Plate V. Fig. 1. Reversionary blue.
Fig. 2. Reversionary blue, dark type. (Exp. 5.)
Plate VI. Fig. 1. Blue with some white feathers.

White Tumbler–White Fantail experiment.

Plate VI. Fig. 2. White with few coloured feathers (black).
Plate VII. Fig. 1. White with few coloured feathers (red).
Fig. 2. Tricolor.

2. The Duke of Bedford's Zoological Exploration in Eastern Asia.—IX. List of Mammals from the Mongolian Plateau. By Oldfield Thomas, F.R.S., F.Z.S.

[Received January 21, 1908.]

After making the collection in the Shantung Peninsula referred to in a previous part of the present series, Mr. Malcolm Anderson made a trip to the Mongolian Plateau, reaching a point about 100 miles N.W. of Kalgan, and collected there the series now enumerated.

The fauna of this region, as was pointed out by Père David, is exceedingly poor, and Mr. Anderson was in consequence only able to get nine species, but these are all of interest, and form a valuable nucleus for further work in Northern China. Most of